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the cavern, the height of the column of water, and the heat generated below."

With this work and the admirable series of photographs by Mr. Jackson (both in sheets \* and stereoscopic form, published by Prof. Hayden) of some of the finest views in the National Yellowstone Park and Colorado Territory, the reader can obtain a very clear idea of the Geyser region, of the springs in course of eruption, and of the falls and basin of the Yellowstone. We see by the papers that it is proposed to open roads into the National Park, and erect hotels at the Geysers for the convenience of the public.

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## ON SOME OF PROF. MARSH'S CRITICISMS.

BY E. D. COPE.

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### I.

I have already (in "The short-footed Ungulata of the Eocene of Wyoming;" Naturalists' Agency, Salem, Mass.) shown, by figures and descriptions, the absence of foundation for Professor Marsh's recent animadversions, and though these latter present internal evidence of idiosyncrasy which almost disarms reply, yet as some of the readers of this journal may not see the above essay, I make a few specific contradictions of some of his statements which may be regarded as serious.

In an article "On the Gigantic Fossil Mammals of the Order Dinocerata," he writes as follows:

"(1) What Prof. Cope has called incisors are canines, etc." I had determined and stated them to be canines, in the American Naturalist, previous to the appearance of this criticism.

"(2) The stout horns he described are not on the frontals but on the maxillaries." I was the first to determine these bones to be nasals, and find that in *Eobasileus* they compose the inner face of the horns to the apex, while the maxillaries form the outer face.†

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\* Sun Pictures of Rocky Mountain Scenery. By F. V. Hayden. The Rocky Mountain Album. By F. V. Hayden and A. H. Jackson, Photographer.

† (See my paper, p. 18). Professor Marsh has since contradicted the former statement flatly.

"(3) The orbit is not below these horns but quite behind them, and has over it a prominent ridge on the frontal." In *Loxolophodon cornutus* the naso-maxillary horn is largely above the orbit, and there is no superciliary ridge of the frontal.

"(4) The occiput is not vertical, but extends obliquely backward, the occipital crest projecting behind the condyles." Prof. Marsh has been perhaps led into this error by the imperfection of the occipital condyles in his specimen. He does not appear to know that in life the head was directed obliquely downwards, so that the occipital crest was vertical as I described it in *Loxolophodon* and in *Uintatherium robustum*.

"(5) The temporal fossa is not small posteriorly but unusually large;" and "(7) the spine of the tibia is not obtuse but wanting," are frivolous; *vide* my descriptions, *l. c.*

"(6) The great trochanter of the femur is recurved, though Prof. Cope says not." It is flat, as in the elephants.

"(8) One of the species named by Prof. Cope, *Eobasileus furcatus*, is based on what he regards as portions of the nasal bones. The description, however, indicates that these specimens are merely the posterior horn-cores of well-known species." In the location of these cores Prof. Marsh may be correct, but demonstration is yet wanting. How "well-known" these species are to Prof. Marsh, will be evident shortly; and how they could be well-known to anybody else, may be determined by reference to his brief notices of a few of them published to the date of his writing.

Omitting notice of sundry insignificant questions raised in a postscript to the paper, as well as those which are more or less repetitions of criticisms already made, I pass to his denial of the possession of a proboscis to these animals. I retain my belief that they had such an organ, and refer to my essay above cited for the proofs. Leidy has suspected its presence in *Megaceratops*. He then says "(7th) the malar bone does not form the middle element of the zygomatic arch, but the anterior as in the tapir." It forms the middle element in *Loxolophodon*, as may be seen from my figures. Below, its maxillary support forms one-third of the zygoma, at the side a little less, and above, a narrow lamina of the malar extends nearly to the lachrymal.

"(9) The nasal bones are not deeply excavated at their extremities." They are excavated, etc., as I have described.

Now it is easy to see by an examination of Professor Marsh's figures of *Uintatherium mirabile* where all this blundering criticism comes from, and I have pointed out to him that this is the source of error. But Professor Marsh evidently desires no such consideration from my hands, but repeats his statements, as though *Uintatherium* were a Rosinante, and the ninth commandment a wind-mill.

There is no inaccuracy in my statement of dates of publication of Professor Marsh's genera. I have never stated that the name *Tinoceras* was proposed August 24th, but that it was referred to the *Proboscidia* at that date. This name was published in an erratum on August 19th, but was never described until September 21st and then only by implication in the description of a species. *Loxolophodon* and *Eobasileus* were described August 19th and 20th, with separate diagnoses.

I am charged with giving an erroneous date to his communication of December 20th before the American Philosophical Society. This will also be found to be correct by reference to the report of my communication (Proceedings Academy Natural Sciences, January 14th, 1873).

Having already gone into the discussion of the affinities of these animals, I run rapidly over the characters assigned by Prof. Marsh to a supposed new order *Dinocerea* (which he now spells as corrected, *Dinocerata*). Those from the first to and including the fourth are entirely trivial; the last, which denies air cavities to the cranium is moreover untrue, as they exist in the squamosal region as I have stated. The fifth is not true of all the genera. The definitions from the seventh to the eleventh are of no weight whatever. As the twelfth, he gives "the very small molar teeth and their vertical replacement." This is precisely the state of things in the proboscidian *Dinotherium*, a form which Prof. Marsh has overlooked. The 13th and 15th, "the small lower jaw," and "absence of hallux" are of no weight if true; but the lower jaw has marked proboscidian features in the symphysis and teeth, and it is probable that some of the species had a hallux. The 16th, "absence of proboscis" is probably an error, certainly so for two of the genera. I have passed over the (6th) "the presence of large postglenoid processes," and (14th) "the articulation of the astragalus with both navicular and cuboid bones," as of some value. They are, indeed, the only characters of any wide systematic sig-

nificance adduced by Prof. Marsh, since they point indubitably to the *Perissodactyla* and are common to all of the *Eobasileidæ*. Nevertheless they form but a slim basis of support for an order of mammals, especially when compared with the uniform testimony of proboscidian affinity derived from the cranial expansions, cervical vertebræ, sacrum, pelvis, hind leg, hind foot, scapula, fore leg, fore foot, and the concurrent evidence derived from dorsal and lumbar vertebræ, dentition and proboscis.

If Professor Marsh wishes to see an equal or greater degree of variation in dentition in an order of mammals, let him compare *Equus* and *Rhinocerus* among *Perissodactyla*, or *Bos*, *Moschus*, *Hippopotamus* and *Phacochærus* in the *Artiodactyla*; in the length of the nasal bones, *Delphinus* and *Squalodon* among *Cetacea*, or *Homo* and some of the lemurs; in the number of toes, *Felis* and *Mustela*, *Ursus*, etc., all members of the same orders.

I should be glad, on the principle of *De mortuis nil nisi bonum*, to commend our critic's remarks on the relations of this supposed order. But Professor Marsh's ideas on classification are derived from unusual sources. The absence of incisor teeth no more relates these animals to the *Artiodactyla* than it relates the sloth to the same order. The presence of paired horns no more constitutes affinity to the ruminants than it does in the case of the "horned-toad."

They are simply an analogous development on a proboscidian basis. The few affinities which this group exhibits outside the *Proboscidia*, are to the *Perissodactyla*, as I was the first to show, and among these, to *Palæotherium* and *Rhinocerus*. As to the name "*Dinocerata*," I have been induced to use it in the sense of a suborder, but am now satisfied that even this use is uncalled for, and shall employ the family name *Eobasileidæ* instead. On equally good bases the camel and *Tragul* should be erected into new orders.

An explanation of the origin of this new order is probably to be found in the system of Mammalia proposed by Prof. Dana, some years since in accordance with his theory of "Cephalization." While I have been able to see beauty in Professor Dana's conception, the least that can be said is that the application to the Ungulata has not been the correct one. The system has not been adopted, and is in the opinion of the best mammalogists, entirely untenable.

Another critic not so courageous as Prof. Marsh, since he is anonymous, has attacked (Am. Jour. Sci. Arts, 1872, 489) my statement of determination of the Cretaceous age of the Bitter Creek coal, citing five authorities as having previously made the same determination. I have shown (Proc. Acad. Nat. Sci. Phila., Jan. 14, 1873) that but one of these references relates to the region in question, and that the critic was ignorant of the geography or literature of the subject, or both. He, however, repeats (loc. cit., 1873, 231) that Mr. Meek "referred Dr. Hayden's collection from Bitter Creek at Point of Rocks to the Cretaceous," a fact I had previously pointed out, and adds that I am in error in asserting that Mr. Meek attached interrogation marks to all his Coalville determinations (200 miles west), as he cites two *Cardia* and two *Inocerami* as from Coalville and without the question. More careful examination would have shown my critic that the two *Cardia* and one *Inoceramus* are stated to be from localities remote from both Coalville and Bitter Creek.

But there is no indication in my original note of a design to ignore the useful labors of the gentlemen who have written on this subject; nothing was farther from my intentions, in so issuing an early notice of my own observations, than to ignore the opinions of Mr. Meek, with which I have become pretty well acquainted through pleasant association on the same geological survey. Had they been coincident with my own, I should have mentioned them, although unpublished. Mr. Meek will, however, soon speak for himself. It requires but a casual examination to show that the criticism is captious and uncalled for, and that its author is only playing aid to the champion above considered.

## II.

I now turn to another subject, the raising of which is due also to Prof. Marsh. He has very commendably made himself acquainted with the literature of the authors who had previously written on these extinct *Proboscidea*, though not in time to prevent his redescribing some of the genera and species. But unfortunately he does not tell us all that he knows. He knows perfectly well that my descriptions antedate his by a month and more, and that he is posterior to Dr. Leidy, by two months at least. He is however not strong enough to state the nomenclature accordingly, but endeavors to prove something else. In order to do

this, he is willing to write (Amer. Journ. Sci. Arts, 1873, p. 118), "the dates on the papers (Aug. 20th and 22d) certainly do not represent those of actual publication;" and again (American Naturalist, 1873, p. 151) "no less than seven of Prof. Cope's papers are antedated, as the records of the society will show." Prof. Marsh is not careful to prevent the natural deduction from these statements, that the dates are fraudulent; though he well knows to the contrary, and disagreeable though it may be to the *mens conscia recti*, I am compelled to prove that such is not the case!

I therefore append testimonials from the proprietors and foremen of the printing establishment from which the essays in question were issued, and from my assistant who received and distributed them:—

PHILADELPHIA, March 24th, 1873.

Professor O. C. Marsh having stated in the "American Naturalist" (1873, p. 151) that some of the papers published by Professor Cope during the summer of 1872, and printed by us, bear dates "which do not represent those of publication" and that "at least seven of them are antedated," we hereby state that these dates are true, and that on the days stated from fifty to one hundred copies of these papers were delivered by us into the hands of Pendleton King and Stephen G. Worth, assistants of Professor Cope, except that on *Metalophodon*, which was issued to Professor Lesley.

MCCALLA & STAVELY.

JNO. S. SCHEIDELL, *Foreman of Composing Room.*  
JOHN DARDES, *Foreman of Press Room.*

LOUISIANA STATE UNIVERSITY,  
Baton Rouge, March 24, 1873.

PROFESSOR E. D. COPE, *Academy Natural Sciences, Philadelphia.*

DEAR FRIEND:—On looking over my papers, I find that I have, among papers written by you, the following:—

On a new genus of *Pleurodonta* from the Eocene of Wyoming, July 11, 1872.

On the Tertiary Coals and Fossils of Osino, Nevada, July 29th.

Descriptions of Some New Vertebrata from the Bridger Group of the Eocene, July 29th.

Second Account of Same, August 3d.

Third " " " " 7th.

On the Existence of Dinosauria in the Transition Beds of Wyoming.

Short Notice of Species of *Loxolophodon* (misprinted *Lefalophodon*) Cope, near August 17th.

Notices of New Vertebrata from the Upper Waters of Bitter Creek, Wyoming Territory August 20th.

Second Notice of Extinct Vertebrates from Bitter Creek, Wyoming, August 22, 1872.

These I brought with me from Philadelphia, leaving early in September, 1872.

I laid them aside during July and August, and am confident that the dates which I find on them, as above, correspond with the times I received them from the printer.

Your instructions were for immediate distribution, which I followed, using the list of names of persons to whom they were to be sent. Some received them very soon, others after a short delay, as suited convenience in mailing; and I think all were mailed by the 1st of September.

You are at liberty to use this letter if desirable. Very truly,

PENDLETON KING,  
*Professor of Natural History in the University of Louisiana.*

I now add testimonials from some of the persons to whom the papers in question were sent, although I consider this part of the evidence as quite immaterial, that which has gone before being

sufficient as to the date of publication. It is indeed not to be expected that persons will generally remember the exact dates at which printed matter has been received. Nevertheless in a few days after making inquiry I received the following:—

"Professor O. C. Marsh having stated in the "*American Naturalist*" (1873, p. 151), that some of the above papers were not published at the dates which they bear, and that "at least seven of them are antedated," I hereby state that most or all the above were received at my address or by me, at or near the dates printed on them, especially those of the summer months."

JAMES ORTON, *Professor of Natural History in Vassar College*, POUGHKEEPSIE, N. Y.

JAMES S. LIPPINCOTT, CORNING, New York.

E. T. COX, *State Geologist*, INDIANAPOLIS, Indiana.

CHAS. M. WHEATLEY, PHOENIXVILLE, Pennsylvania.

WM. C. KERR, *State Geologist*, RALEIGH, North Carolina.

JOSEPH SAVAGE, LEAVENWORTH, Kansas.

I have also received letters from Principal Dawson of Montreal and Professor Mudge of the State Agricultural College, Kansas, stating that they received the papers, but did not keep exact account of the date of reception. Among many others in the United States to whom they were sent, I may mention Prof. Davidson, President of the San Francisco Academy Natural Sciences. They were also sent to Professors Seeley, Huxley, Gegenbauer, Peters, Hyrtl, Du Bocage and others in Europe, and Messrs. Gotch and Rijgersma in Australia and the West Indies respectively.

I also add that they were received at my address at Fort Bridger, and mostly forwarded to me promptly after the dates of distribution.

The little that interests students in this matter is the dates of publication of the essays in question. The dates of reading are of secondary importance and have been abandoned by naturalists generally as furnishing basis for nomenclature, so that Prof. Marsh's able criticism of the dates on the cover of the American Philosophical Society's proceedings for 1872 may be regarded as purely antiquarian. The papers in question were, in fact, issued independently of the society, and almost always in advance of the time at which they were read before it. But lest our bibliophile again charge me with fraud, let me here correct an error in the report of the proceedings of that society for August, 1872, in "*Nature*" for 1873, p. 335. Here it is stated that my first note on the Proboscidiæ was read on August 16th; I hasten to say that this is an error probably derived from the wording of the note as published on August 19th, in which it was stated (without my knowledge) that "The Secretary announced that he had re-



ceived from Prof. Cope," etc. This could only have referred to the last meeting preceding (on the 16th) ; but, in fact, it was not read until the meeting following (September 20th). In the mean time it had been published (on the 19th), and two other papers describing the species and genera in more detail were published on the 20th and 22nd respectively. An account embracing the same facts was also read by Prof. Winchell before the American Association for the Advancement of Science, which opened its sessions at Dubuque on August the 21st (or 23d), of which an abstract has, after great delay, appeared in the American Naturalist for March, 1873. Finally a description of *Eobasileus* appeared in the scientific column of the "New York Independent" for August 22nd, 1871. The papers published in Philadelphia were issued without my revision, and hence contain a few typographical errors which Prof. Marsh finds of great use to himself. But under the circumstances the number is surprisingly few.

I now present a table of the nomenclature of the three genera of *Proboscidea*, synonymy being in italics :—

MONTH.	AUTHOR.		
	Leidy.	Cope.	Marsh.
August, 1872.			
1st.	<i>Uintatherium</i> described with one species. <i>Uintamastix</i> do.		
19th.		<i>Loxolophodon</i> described with three species.*	<i>Tinoceras</i> used in erratum, not described; no species described.
20th.		<i>Eobasileus</i> described and one species.	
22d.		<i>Loxolophodon</i> again described with three species.	
24th.			<i>Tinoceras</i> named; no description.
September.			
21st.			<i>Tinoceras</i> described with one species described.
27th.			<i>Dinoceras</i> described with two species.

\* In this communication the name *Loxolophodon* was misspelled *Lefalophodon*. As Prof. Marsh finds some difficulty in adopting the former name, I can accept the latter, should he insist on it.

Though Prof. Marsh has published five papers and six notes on these animals, but one of his species has been so far partially described as to be of any use to science. Publishing of bare names \* may constitute a caveat, but not an injunction, but in the present case the dates are too late. Hence the trouble. "*Hæu quantus erat sudor,*" etc.

In one of Prof. Marsh's late catalogues, he asserts that *Loxolophodon cornutus* and *Tinoceras grandis* are identical. If this be true, the latter name must stand as a synonyme of the former, and *Tinoceras* be withdrawn from the synonymy of *Uintatherium*, where it might well remain so far as his description characterizes it. But if so, his statement that there are five superior molars must be altered, as the genus *Loxolophodon* possesses six. He has also stated that *Uintatherium robustum* possesses a small tubercle on one of the molars not found in *U. mirabile*, and bases a generic distinction between the species thereon; for use he at last succeeds in defining the latter as a species only.

Perhaps, however, Prof. Marsh desires to impose upon scientific literature the numerous names he has proposed for species he has never described.† This he has attempted in the case of the fossil American Turkey, *Meleagris superbus* Cope, which was described by the writer over a year sooner than by him. At the latter date this species was discovered to have been called *M. altus* Marsh, some months prior to my description, but without any allusion to its characters or other means by which it could be identified. If Prof. Marsh desires students to use his museum labels, without descriptions, he might refer to Bronn's "*Lethæa Geognostica*," and other works, where he will find all such names consigned to the rubbish of synonymy so soon as it can be ascertained to what they refer.

To sum up the matter, it is plain that most of Prof. Marsh's criticisms are misrepresentations, his systematic innovations are untenable, and his statements as to the dates of my papers are either criminally ambiguous or untrue. I might now proceed to

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\* See the rule "adopted and practiced by most students. In case of a genus there must be a definition giving the essential characters." From "Thorell's European Spiders," quoted in Wallace's Address before the Entomological Society, London, and by W. H. Edwards in "Entomological Nomenclature" in "Canadian Entomologist," 1873, p. 32.

† Several of which owe their existence in literature to the descriptions which I have given, e.g., *Thecachampsia squankensis* "Marsh," *Hadrosaurus minor* "Marsh."



*Loxolophodon cornutus* Cope.

*Loxotophodon cornutus* (type)

$\frac{1}{6}$  nat. size.



characterize the effrontery of such proceedings in fitting terms, but forbear, believing that with a little change of scene the author of them will be as glad to bury them in oblivion as is the writer of this notice.

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#### EXPLANATION OF PLATES.

PLATE 4. Front view of cranium of *Loxolophodon cornutus*, one-sixth natural size.

PLATE 5. Profile of the same (not in natural position) same proportion; compare with description.

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### NEW PLANTS OF NORTHERN ARIZONA AND THE REGION ADJACENT.

BY SERENO WATSON.

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IN the botanical collections made in 1871-'72, mainly in the southern portion of the Great Basin, in northwestern Arizona and the adjacent desert section of California, by Mr. Ferd. Bischoff and others, under the direction of Lieut. G. M. Wheeler, Corps of Engineers, in the course of his exploration of that region, several new species have been found which are here described, by consent, in anticipation of the fuller report now in preparation. With these are given some others occurring in a small collection made by Mrs. Ellen P. Thompson near Kanab, Southern Utah, during the last summer while accompanying her brother, Maj. Powell, in his survey of the Colorado. Several of these species are of interest as confirming genera hitherto monotypical. Notes upon a few other species are added.

**POLYGALA SUBSPINOSA.**—Perennial, herbaceous, glabrous or more or less pubescent; stems 2-8' high, branched above, the branches often spinose; leaves scattered,  $\frac{1}{2}$  to 1' long, oblong or oblanceolate, acute or obtuse, attenuate to the base; raceme loose, few-flowered; bracts small and scarious; pedicels becoming reflexed, shorter than the flowers; sepals naked or ciliate, the wings oblong, 4-5" long and equaling the petals; keel hooded, crested with a broad saccate process; style linear; capsule orbicular, emarginate, short-stipitate.—Near *P. Nutkana*, which has a linear or horn-shaped crest and is always nearly or quite glabrous and without spines. Silver City, Nevada (Kellogg, 1862), pubescent and very spiny; Arizona (Palmer), densely pubescent but without spines; Kanab (Mrs. E. P. Thompson), glabrous and spiny. Flowers "maroon and yellow;" on mountain summit; June.

**PETALOSTEMON FLAVESCENS.**—Stem simple, glabrous; stipules and leaves sparingly silky; leaflets 3-5, narrowly oblong, obtuse, 3-6" long; spike dense, long-peduncled, the rachis subpubescent; bracts (and calyx) very silky-villous, subulate, 2" long; upper tooth of the calyx subulate, narrowest and longest, equaling the tube; petals yellow, the limb of the banner quadrilateral, emarginate, equaling the claw, the